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(54) Abstract Title
Water-soluble packaging systems

(57) A container comprises an inner water-soluble or water-dispersible encapsulate 25 in the form of a thermoformed vessel 15 and a lid 12 sealed thereto at 36, received in a protective external, thermoformed, water-resistant/water-insoluble casing 11. An array or series of the containers may be joined together side by side in a web, eg by the respective casings 11 all being pans of a single sheet. The casings may have peelable lids 35 sealed thereto at 37. The casings 11 and vessels 15 may be formed from superimposed webs of film thermoformed into cavities at 13, Figure 1, filled at 14 and then having a lidding film applied thereon to form the lids 12. Surplus lidding film and vessel material between containers may then be cut at 17 and removed at 18, and a further lidding film 19 applied to form the lids 35 of the casings 11. The encapsulate 25 may be made of flexible polyvinyl alcohol film and the casing 11 be of semi-rigid plastics.

Figure 1

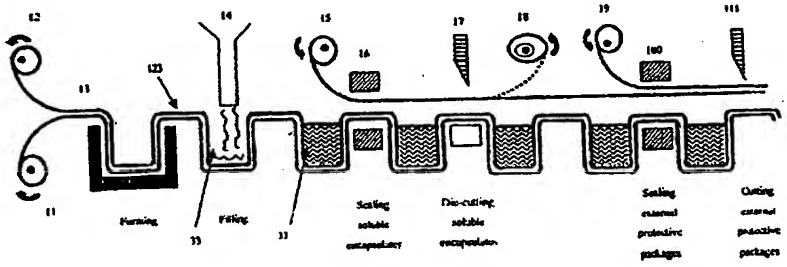

Figure 3

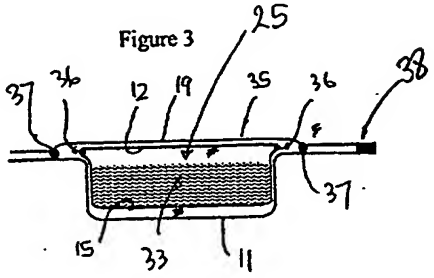

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Figure 1

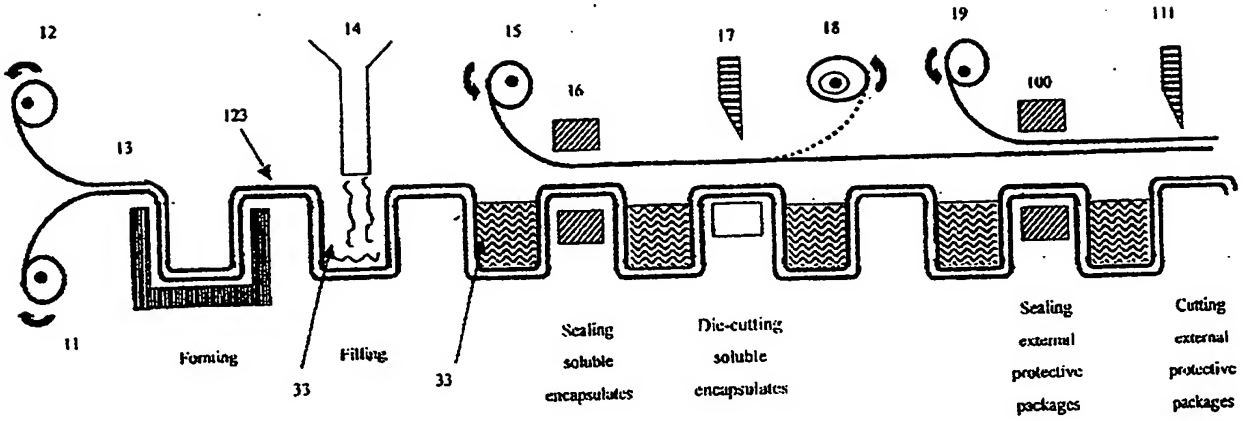


Figure 2

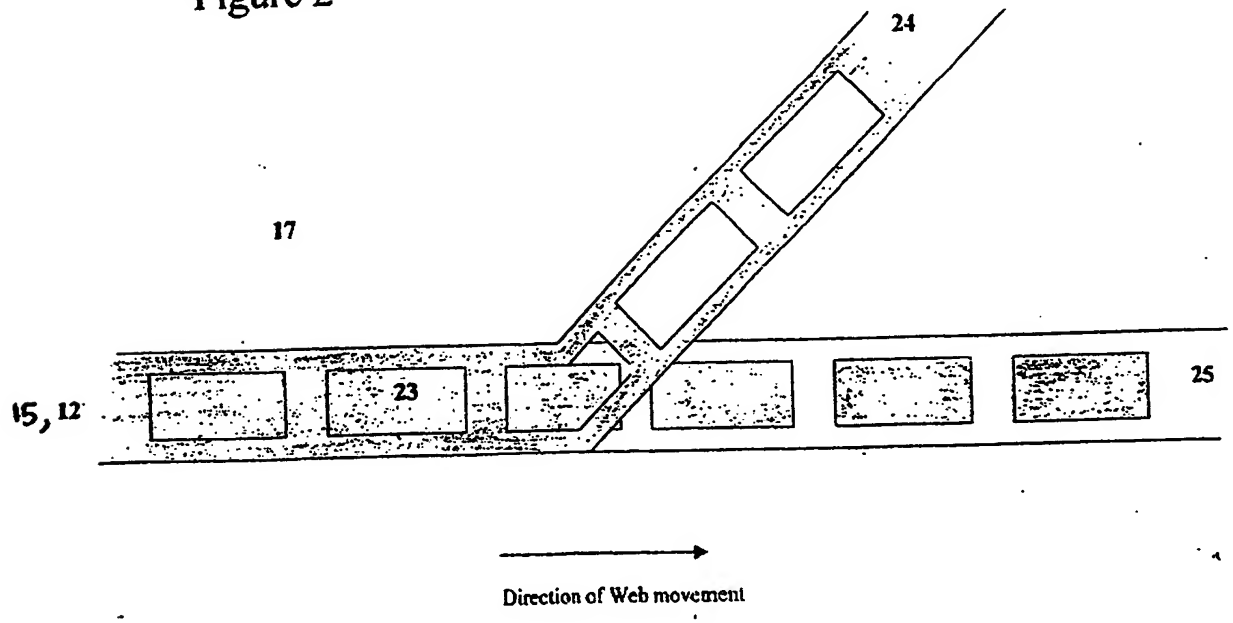
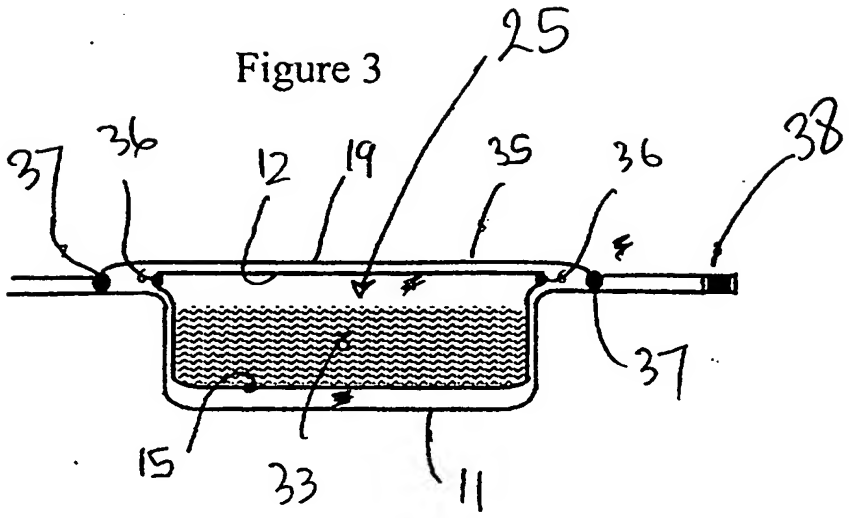


Figure 3



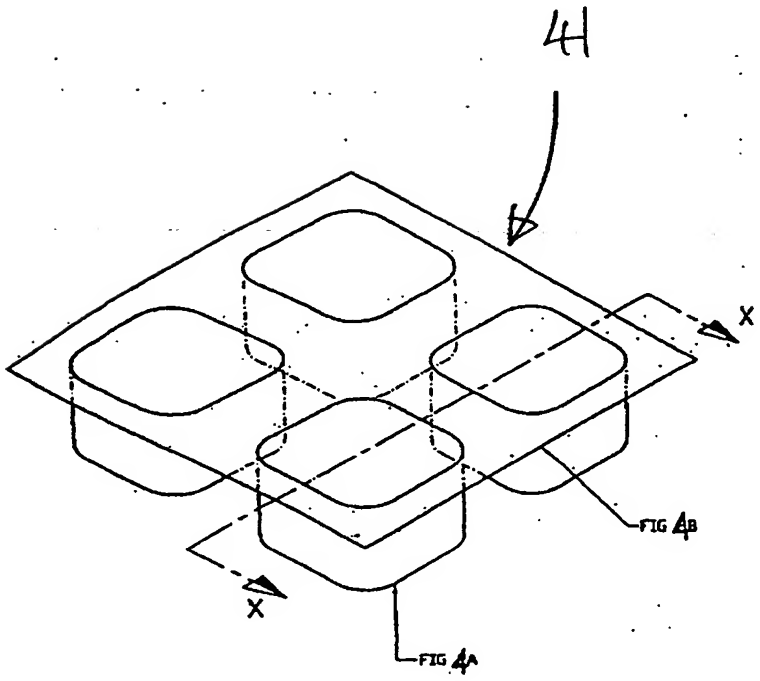
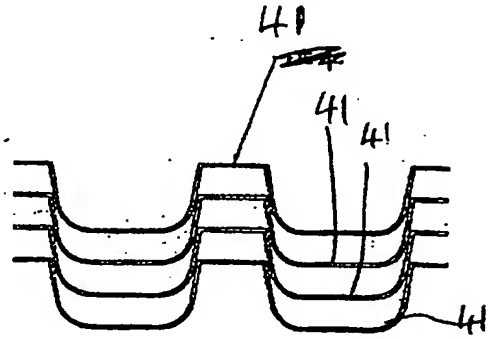


FIG 4



ELEVATION CROSS SECTION ON X - X

Packaging systems

This invention is concerned with packaging systems, and relates in particular to an improved thermoformed packaging system incorporating a water-soluble or water-dispersible envelope. The package of the invention is particularly useful for pharmaceuticals, pesticides, biocides, and washing or cleaning materials.

Thermoformed water-soluble packages are known, but some have limitations, one of which is caused by the propensity of thermoformed water-soluble film to undergo "shrink-back", which prevents the volume of a formed cavity being fully utilised at the filling stage. The present invention seeks to provide improved packages, and packaging systems, better suited for containing pharmaceutical, pesticidal, biocidal, or washing or cleaning compositions. More specifically, the present invention seeks to provide an easy-to-make, easy-to-fill and easy-to-use package. For this purpose it proposes a packaging system wherein each individual container of a multiplicity of such containers all joined together in a group side by side in a web comprises an inner water-soluble or -dispersible encapsulate enclosed wholly within a protective external water-insoluble casing, and each of the encapsulate and the casing is, separately, in the form of a thermoformed hollow body and a lid and is made from two films bound together by one common seal, so that each encapsulate is in contact only with the inner wall of its casing.

In one aspect, therefore, this invention provides a packaging system, useful for making a multiplicity of individual containers all joined together in a group side by side in a web, wherein each individual container comprises an inner water-soluble or -dispersible encapsulate, in the form of a thermoformed vessel and a lid and made from two films bound together by one common seal, enclosed within a protective external water-resistant/water-insoluble casing in the form of a thermoformed holder, optionally with a peelable lid and then also made from two films bound together by one common seal, so that each encapsulate is in contact only with the inner wall of the casing.

In such a packaging system each encapsulate - the inner water-soluble or water-dispersible envelope - may be filled with any one or more of a wide variety of materials, typical ones being ingredients or compositions useful for pharmaceuticals, pesticides, biocides, detergents, materials for fabric washing or fabric care, for surface washing or surface care, and for dishwashing, and deodorants, dyes, pigments, or water-treatment chemicals. The fillings may take any appropriate form - they may for instance be liquids, gels, pastes, solids, granules or powders. The invention's packaging system is, however, most useful for containing liquid compositions. A typical such product is a thickened liquid detergent formulation.

The material for the walls of the water-soluble/ -dispersible compartment - the encapsulate (or envelope) - can be hot- or cold-water soluble or dispersible, and can be flexible or rigid. Preferably, it is a film, or a combination of two different films, which is both

water-soluble and flexible. By cold-water soluble is meant a material which is soluble in water at 20°C or less, while by hot-water soluble is meant a material which is soluble in water at 60°C or more. The encapsulate can be made from films of different grades, from films of different thicknesses, or from films which have been perfumed or coloured to obtain the desired characteristics, or from any combination of these.

Preferred materials for the encapsulate are PVOH (polyvinyl alcohol) and cellulose ether. They are also generally injection-mouldable, and do not hold a static charge. However, other water-soluble compounds that can be used include polyglycolides and polylactides, and polylactide-polyglycolide copolymers. These materials may of course also, if necessary, contain components such as plasticizers and mould release agents which beneficially modify their properties - and all of them can naturally include other components such as colouring agents.

The thickness of the walls of the encapsulate is conveniently in the range 20 to 500 microns.

A typical water-soluble film for the encapsulate's vessel is made of that variety of 75 micron PVOH available as MONOSOL M8534. A typical film for the vessel's lid is made of that variety of 60 micron PVOH available as SOLUBLON PT60.

The thermoformed water-insoluble/resistant material for the external protective casing is preferably semi-rigid. Polyester and nylon/polyethylene laminates are convenient for this purpose, preferably in their amorphous form.

The thickness of the walls of the water-resistant or insoluble compartment is conveniently in the range of 60-1000 microns, preferably 170-750 microns.

A typical water-insoluble/resistant film is 170 micron thick and made from amorphous polyester APET; this is suitable for both the holder and its lid.

The encapsulate's vessel and the casing's holder are essentially cavities or compartments the one for containing the substance being packaged and the other for containing, and protecting, the first one. These can be of any suitable shape, but preferably they are each in a slightly tapered cylindrical shape (perhaps with a squarish cross-section), so that a good release from the mould is achieved. In addition, with such a shape one then fits neatly inside the other, so that (as described hereinafter) a set of lined casings *without* lid portions can be nested to form a space-saving stack.

In a second aspect the invention provides a method for making containers of the invention, and in particular for making a web or group of such containers joined side by side, in which method:

a. a thermoformable water-soluble or -dispersible lining film in sheet form is positioned face to face with a thermoformable water-insoluble or -dispersible carrier film in matching sheet form to make a base web combination, and this base web is fed into a thermoformer and there moulded into a sequence of cavity or bowl container shapes with the water-soluble or -dispersible film as a lining on the inside, for each shape the combination being

the encapsulate's vessel within the casing's holder;

b. the encapsulate's vessel is filled with the relevant material to be packaged;

c. a water-soluble or -dispersible lid film in sheet form is placed over the thus-formed lined and filled container shapes, and sealed to the lining film around the mouth of each container shape, forming a lid for the vessel therein, this lidded vessel being the encapsulate, and the lid and lining films are then cut through to separate each encapsulate from its neighbours;

d. the areas of waste lid and lining film between the encapsulates are removed, exposing the underlying carrier film; and, optionally,

e. a water-insoluble lid film in matching sheet form is placed over the thus-separated and -spaced casing-borne encapsulates so as to cover them, and is removably sealed to the previously-exposed carrier film so as to form for each casing's holder a lid which may be peeled back to expose the encapsulate therein for subsequent removal and use.

The web may be formed on a continuous basis, with many side-by-side rows/sets of containers. How many depends on the width of the sheet; if narrow, like a tape, there might only be one container (so that the method produces a strip of containers), while if wide there might be two, three or more containers in each row. Clearly, the length of the web is indefinite. Once formed, of course, the web can be cut into the more conveniently-sized packs - of two-by-two containers, say - required for sale. At that time the peelable holder lidding film is cut to allow the lid of each pack to be

removed without damaging the hermetic seal of neighbouring packs.

Although in this method the shaping, filling and lidding is most likely to be done all at the same time, it is of course possible to break it into quite widely time-separated stages. Thus, the shaping could be followed by the storing of the formed shapes as "pre-forms", optionally having first cut the sequence of containers into manageable and convenient lengths, and at some later time these pre-forms could be filled, and lidded. Moreover, it is a possibility, though not a preferred one, *not* to apply the final, water-insoluble or -dispersible film that forms the casing's holder's lid but instead to leave the container as just the encapsulate sitting inside its open-topped holder.

The sealing effected in the method of the invention can be done by any appropriate means - for example, by heat welding or by ultrasonic, laser, radio frequency or solvent welding, or a combination thereof. Heat sealing, laser sealing and solvent welding or combinations thereof are preferred.

An embodiment of the invention is now described, though by way of illustration only, with reference to the accompanying diagrammatic Drawings in which:

Figure 1 shows the stages of the method of the invention;

Figure 2 shows that moment in the method during which the waste sealed lid/lining films are removed;

Figure 3 shows a section through a container of the invention; and

Figures 4A&B show a pre-form made during the method of the invention, and a stack of such pre-forms nested together.

Figure 1 shows a water-soluble PVOH film (12) being fed from a roll into the thermoformer (13: the actual forming apparatus is not itself shown) in contact with and on top of the carrier film web (11) to form a combined base web (123). This combined base web is drawn through the machine without the need for any special unwind or tension control.

In the thermoforming process both the PVOH film 12 and the carrier film 11 are formed simultaneously. The PVOH film clings to the carrier film, and the carrier film produces a cavity form which holds the formed PVOH film within itself. If the combined base web 123 is examined closely after forming, it will be seen that the

PVOH film is held so well within the carrier film that it is not obvious without close physical examination that there are two different films within the formed base web.

It is important to understand that at this stage of the process the two films 12,11 can be easily separated to reveal a well-defined PVOH cavity. If left for a period of time, the formed PVOH film will start to shrink back, but the time required for this to take place is considerably extended, compared to the rate of shrink-back of a PVOH film which has not been "carried" in this way. Full advantage of this is taken when, after forming, the combined base web 123 cavity is then filled (by filling machine 14) with whatever filling (33) is required; the shrink-back of the PVOH film cavity is conditioned by that of the carrier film, which is almost insignificant.

Once filled, there is constructed the desired water-soluble encapsulate by sealing thereover (at the thermoformer's sealing station 16) a second PVOH film (15) as the top web (as noted earlier, the PVOH *top* web film 15 may be of a different thickness or a different type from the PVOH *base* web film 12 in order to bestow different properties on the encapsulate). In a typical application, the PVOH top web 15 is thinner than the PVOH bottom web 12 as it has not had to undergo forming (during which some thinning of the film inevitably takes place, particularly at any corners present in the cavity).

The filled and sealed water-soluble encapsulate is still being carried by the carrier film. It is important to understand that, although carried by the carrier film throughout the sealing process, the encapsulate has not become welded to the carrier film

during that sealing process. This is because PVOH - or whatever the water-soluble or water-dispersible film material is - is a hydrophilic material, while the carrier film is (most preferably) a hydrophobic material (most water-insoluble films currently preferred for thermoforming are hydrophobic). As a result, it is not possible to form a heat weld between the carrier film 11 and the PVOH film 12.

Figure 1 shows how the carrier film 11, rather than being put to waste (as in the case of many other carrying devices when their function has been fulfilled), is used as an integral part of the secondary (protective) packaging for the water soluble encapsulate. First, though, it is necessary to separate the individual water-soluble encapsulates making up the sequence of these encapsulates. This is effected by cutting - *die*-cutting (at cutting station 17) - through the two water-soluble lid and lining films (top and base webs 15,12) around the seals but not through the underlying carrier film 11, and then removing the waste "in-between" material at a rewind station (18) (this is also shown in Figure 2). This die-cutting process is conventional; it is similar to that used in the flat bed die-cutting of self-adhesive labels (in which only the self-adhesive face material is cut, leaving the self-adhesive label adhering to the uncut "siliconed" release material).

Figure 2 shows a plan view of this operation. After cutting the combined water-soluble films (top and bottom webs 15,12) at the die-cutting station 17, leaving the die-cut-around portions (23) in place, the waste (24) is removed upwards to a rewind station 18 leaving behind the now completely-separate water-soluble

encapsulates 25 held in the cavities of the carrier film 11.

Once the water-soluble encapsulates have been die-cut, and the PVOH lid/lining waste removed, a top web (19) of water-resistant film is sealed over the sequence (at heat-sealing station 100). This top web 19 of water-resistant film, which need not necessarily be of the same material or thickness as the carrier film 11, needs only to be capable of being reliably (and preferably peelably) sealed to the carrier film, but during this process care must be taken not to trap the edges of the flanges of the water-soluble encapsulates in the formed secondary seal. The finished sequence of webbed containers can then be cut into groups, or into individual containers, at a final cutting station (111).

In Figure 3 there is shown a cross-sectional view of one example of a single container (or pack) according to the invention. The product (33) is enclosed between the two layers of water-soluble lid and lining film 15,12 sealed at the periphery (36), and the resulting water-soluble encapsulate 25 is entirely enclosed within the two water resistant films 11,19, which are sealed around the periphery of the encapsulate with peelable seals (37). This enables the outer lid (35) to be readily peeled away from the carrier film 11, allowing the soluble encapsulate 25 with its product 33 to be elegantly dispensed. If, for any reason, the lid 35 is required to remain attached to the carrier film 11 after peeling open the pack, the lid may be additionally sealed on one side only with a further seal (38) which is *not* peelable.

Typically, the top web of water resistant film 19 is sealed to the carrier film 11 with a peelable seal which, whilst hermetically sealing the pack from ingress

of contaminants, particularly water, also allows a pull tab or other opening device (not shown) located at the corner of each individual compartment of the pack to be used to gain easy access to the water-soluble encapsulate 25 contained within. The product can then be unit dosed elegantly, leaving the remainder of the encapsulates protected as in a pharmaceutical blister pack.

A further embodiment of the invention is one where the carrier film 11 is used as the only component of the protective packaging of the water-soluble encapsulate 25. It is still necessary to separate the water-soluble encapsulates by die-cutting or stamping through the two PVOH films (top and base webs 15,12) around the seals but not through the carrier film and, in the case of die-cutting, the waste PVOH lid/lining films are again removed at a rewind station 18. However, here the process is interrupted after die-cutting such that the second web of water-resistant film 19 is not applied. The carrier film 11 within which the water-soluble encapsulates 25 reside after die-cutting may be retained and cut into trays containing a plurality of packs for stacking or display purposes.

A yet further embodiment of the invention is described with reference to Figure 4. The process illustrated in Figure 1 is interrupted before the filling stage 14, and the web is moved directly on to the cutting and separation stages 17,18 in order to produce empty so-called "pre-forms" (41) for storage and later use. Figure 4 shows an example of such a pre-form, and how several of these can be nested for

efficient storage provided that the cavity has a sufficient taper, narrowing towards the base. It is evident that the pre-forms, complete with their PVOH liner, can be stored, and then at a later date filled with product and fed through a simple lidding and cutting machine (such as those produced by Tiromat and Multivac) to produce the water-soluble encapsulates 25 which are each individually supported by the carrier film but not completely protected by it.

The packaging system of the invention has many advantages, some of them being as follows:-

a) Shrinkage of the water-soluble/dispersible film between forming and sealing is substantially limited.

b) The water-soluble/dispersible film can be thermoformed without losing its shape and volume due to shrink-back.

c) The process can be run at increased speeds with reduced risk of contamination of the seals by spillage.

d) The finished pack greatly improves storage, handling and dispensing of the product.

e) PVOH films with otherwise desirable properties but especially susceptible to shrink-back can be used efficiently.

f) As the PVOH base web film is supported by the carrier film, the suction holes in the cavity forming mould will not be in contact with the PVOH film, thus eliminating any risk of damage to the PVOH film during forming.

g) The formed cavities of carrier & PVOH films combined may be separated, singly or in a plurality of units, before filling with product. These unfilled cavities may then be stored and used at a later date. These "pre-forms" will nest and store economically, and require less sophisticated equipment to fill and seal.

h) A package can be produced where the carrier film is the required packaging and the PVOH provides a "barrier" lining. The package will then be able to contain many products that the carrier film alone may not be able to contain, such as perfumes, odours, oils, fats and greases. The package will also act as a barrier to oxygen.

Claims

1. A packaging system, useful for making a multiplicity of individual containers all joined together in a group side by side in a web, wherein each individual container comprises an inner water-soluble or -dispersible encapsulate, in the form of a thermoformed vessel and a lid and made from two films bound together by one common seal, enclosed within a protective external water-resistant/water-insoluble casing in the form of a thermoformed holder.

2. A packaging system as claimed in Claim 1, wherein the protective external water-resistant/water-insoluble casing in the form of a thermoformed holder has a peelable lid, and then is also made from two films bound together by one common seal, so that each encapsulate therewithin is in contact only with the inner wall of the casing.

3. A packaging system as claimed in either of the preceding Claims, wherein the material for the walls of the water-soluble/-dispersible encapsulate is a film, or a combination of two different films, which is both water-soluble and flexible.

4. A packaging system as claimed in Claim 3, wherein the encapsulate material is PVOH (polyvinyl alcohol) or cellulose ether.

5. A packaging system as claimed in any of the preceding Claims, wherein the thickness of the walls of the encapsulate is in the range 20 to 500 microns.

6. A packaging system as claimed in any of the preceding Claims, wherein the encapsulate's vessel is

made of 75 micron PVOH, and the vessel's lid is made of 60 micron PVOH.

7. A packaging system as claimed in any of the preceding Claims, wherein the water-insoluble/resistant material for the external protective casing is semi-rigid.

8. A packaging system as claimed in Claim 7, wherein the casing material is a polyester or a nylon/ polyethylene laminate, in amorphous form.

9. A packaging system as claimed in any of the preceding Claims, wherein the thickness of the walls of the water-resistant or -insoluble casing is in the range of 60-1000 microns.

10. A packaging system as claimed in Claim 9, wherein the wall thickness is 170-750 microns.

11. A packaging system as claimed in Claim 10, wherein the water-insoluble/-resistant film is 170 micron thick amorphous polyethylene terephthalate.

12. A packaging system as claimed in any of the preceding Claims, wherein the encapsulate's vessel and the casing's holder are each of a nestable, tapered cylindrical shape.

13. A packaging system as claimed in any of the preceding Claims and substantially as described hereinbefore.

14. A method for making containers as claimed in any of the preceding Claims, in which method:

a. a thermoformable water-soluble or -dispersible lining film in sheet form is positioned face to face with a thermoformable water-insoluble or -dispersible carrier film in matching sheet form to

make a base web combination, and this base web is fed into a thermoformer and there moulded into a sequence of cavity or bowl container shapes with the water-soluble or -dispersible film as a lining on the inside, for each shape the combination being the encapsulate's vessel within the casing's holder;

b. the encapsulate's vessel is filled with the relevant material to be packaged;

c. a water-soluble or -dispersible lid film in sheet form is placed over the thus-formed lined and filled container shapes, and sealed to the lining film around the mouth of each container shape, forming a lid for the vessel therein, this lidded vessel being the encapsulate, and the lid and lining films are then cut through to separate each encapsulate from its neighbours; and

d. the areas of waste lid and lining film between the encapsulates are removed, exposing the underlying carrier film.

15. A method as claimed in Claim 14, in which:

e. a water-insoluble lid film in matching sheet form is placed over the thus-separated and -spaced casing-borne encapsulates so as to cover them, and is removably sealed to the previously-exposed carrier film so as to form for each casing's holder a lid which may be peeled back to expose the encapsulate therein for subsequent removal and use.

16. A method as claimed in either of Claims 14 and 15, in which the web is formed on a continuous basis, with many side-by-side rows/sets of containers in columns of indefinite length, and then cut into the smaller packs required for sale, at which point the peelable holder lidding film is cut to allow the lid of each pack to be

removed without damaging the hermetic seal of neighbouring packs.

17. A method as claimed in any of Claims 14 to 16 and substantially as described hereinbefore.

Amendments to the claims have been filed as follows

Claims

1. A packaging system in the form of a multiplicity of individual containers all joined together in a group side by side in a web, wherein each individual container comprises an inner water-soluble or -dispersible encapsulate, in the form of a thermoformed vessel and a lid and made from two films bound together by one common seal, enclosed within a protective external water-resistant/water-insoluble casing in the form of a thermoformed holder.

2. A packaging system as claimed in Claim 1, wherein the protective external water-resistant/water-insoluble casing in the form of a thermoformed holder has a peelable lid, and then is also made from two films bound together by one common seal, so that each encapsulate therewithin is in contact only with the inner wall of the casing.

3. A packaging system as claimed in either of the preceding Claims, wherein the material for the walls of the water-soluble/-dispersible encapsulate is a film, or a combination of two different films, which is both water-soluble and flexible.

4. A packaging system as claimed in Claim 3, wherein the encapsulate material is PVOH (polyvinyl alcohol) or cellulose ether.

5. A packaging system as claimed in any of the preceding Claims, wherein the thickness of the walls of the encapsulate is in the range 20 to 500 microns.

6. A packaging system as claimed in any of the preceding Claims, wherein the encapsulate's vessel is

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Application No: GB 0111608.6
Claims searched: 1-17

Examiner: Stephen Smith
Date of search: 12 July 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B8C(CPA, CP9)

Int Cl (Ed.7): B65D 65/46, 77/04, 77/06

Other: ONLINE: EPODOC, PAJ, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	WO 94/02381 A1 (CIBA-GEIGY) lines 11-26 of page 4	1, 3-5
A	WO 93/22215 A1 (RHONE POULENC)	
Y	WO 92/17382 A1 (RHONE POULENC) lines 3-17 of page 4	1, 3-5
A	US 5403096 (AAGESEN)	

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